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Original Article

Comparison between the use of vitamin d supplement by 20-49 year old women and their nutrition and depression status

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Abstract. *Objective:* Aim of this study is to determine the possible relation between the nutritional status, food choices, eating habits, and Vitamin D supplement use of pregnant women between 20-49 years of age, and depression. *Methods:* The study was conducted between December 2018 and January 2019, on a total of 150 pregnant women between the ages of 20 and 49, who were admitted to Ankara Atatürk Training and Research Hospital Obstetrics and Gynaecology Policlinic. A questionnaire was used in order to identify personal data of the individuals, levels of serum Vitamin D, depression status, physical changes and other information regarding the changes in food consumption. Dietary habits and food consumption records of the individuals were obtained through face-to-face interviews. *Results:* A total of 75 individuals participating in the study used Vitamin D, while the other 75 did not. Of the individuals participating in the study, beck depression score median of those who used Vitamin D was found as 9.00 (IQR =6), while it was 33.00 (IQR =13) for those who did not. When the scores were analyzed based on Vitamin D use, it was found that there were statistically significant differences. *Conclusions:* There is evidence from epidemiological studies that show that vitamin D deficiency or insufficiency is associated with depression. Therefore, it is appropriate to recommend taking vitamin D supplements to prevent or treat depression in risk groups. Larger studies are needed to examine this situation in detail.

Key words: Nutritional status, Vitamin D, Pregnancy, Depression, Dietary habits

Introduction

Besides being one of the most remarkable experiences in life, pregnancy is also a period when women go through psychological, biological, and emotional changes (1). Pregnancy is a process where various maternal hormones are secreted and metabolic changes occur in body to ensure optimal fetal growth. In such a period, where women prepare themselves against the physical and physiologic needs brought by pregnancy, they must also make sure that their needs for micronutrients are fulfilled as much as the needs for macronutrients (2). During pregnancy, micronutrient requirements increase in line with the changing physiology and homeostatic control (3). According to the developmental origins of health and disease hypothesis, most of the conditions occurring in adulthood stem from fetal life. Pregnancy is specifically a sensitive period in terms of future status programming (4).

Application of vitamin supplement in perinatal period has become standardized. Growth and development of the fetus depend on the essential foods and vitamins taken by the mother. Vitamin D deficiency and inadequacy in perinatal and lactation periods may

negatively affect both baby's and mother's health, as well as their future lives. Debates on the reference range for 25(OH)D level and daily Vitamin D intake still continue. Additional Vitamin D intake might be performed during pregnancy, in order to prevent Vitamin D deficiency and inadequacy. Pregnant women must be advised to be exposed to direct sunlight for at least three times a week, depending on certain characteristics, such as daily habits, way of dressing, color of their skin, or weight. Risk groups, such as those with low socioeconomic and cultural backgrounds or nutritional disorders must be also observed in terms of Vitamin D deficiency (5).

As well as being a natural life experience, pregnancy is a period in a women's life where she goes through substantial biological and psycho-social changes and has the risk of encountering with several factors that may cause concern and stress (6).

Studies conducted in recent years indicate that Vitamin D might be connected with depression. Several epidemiologic researches showed the negative correlation between 25 (OH)D level and depression (7,8,9). Presence of Vitamin D receptors (VDR) within a location in the brain that may be in relation with depression reinforces the thesis of its role in the etiology of depression (10).

Method and material

Individuals: The study was conducted on a total of 150 pregnant women between the ages of 20-49, who were to Ankara Atatürk Training and Research Hospital Obstetrics and Gynecology Policlinic between December 2018 and January 2019, and voluntarily accepted to participate in the study. The study consisted of individuals who had no gastrointestinal, renal or hepatic, and endocrinal diseases (particularly hyperthyroid, hypothyroid, diabetes etc.); did not use any medication; had no case history that involved a psychiatric disease or a serious trauma experienced in the childhood; were not on a special diet; did not receive any hormonal treatment during the last two months; and did not use any antidepressants.

Socio-demographic Features: In the study, a questionnaire form was used in order to identify personal data of the patients. The form contained questions regarding the demographic features (age, occupation, level of education, age of first pregnancy, number of children), smoking and medication statuses of the patients.

Collecting Dietary Records: Here, the questionnaire designed to identify the dietary habits of patients, and records of food consumption were filled by the researcher through face-to-face interviews. In order to identify the energy and nutrient intakes, food consumption of the individuals were recorded through 24-hour dietary recall method for three days (two weekdays and one day on a weekend).

Identifying the Nutritional Status of the Individuals: The book entitled "Catalog of Food and Nutrition Photographs: Measures and Amounts" was utilized while collecting food consumption records (11). On the other hand, "Standard Meal Recipes" was used while identifying the amounts of nutrients added in the meals consumed (12). Types and amounts of nutrients added in the food and drinks prepared by the individuals at home were questioned with the help of the catalog and recorded in the food consumption form. Standard meal recipes were utilized for the amount of nutrients contained in the foods and drinks consumed outside home. After determining the amount of the food consumed; energy and nutrients taken during daily diet were reviewed in terms of energy, macro and micro nutrient intakes on daily meal basis (breakfast, lunch, dinner, and three snacks), by using the full version of Computer-Aided Dietary Program, Nutrition Information Systems Packaged Software 72 (BEBIS 72) developed for Turkey (13).

Data on the calculated energy and nutrients were analyzed in accordance with Dietary Reference Intake Level (DRI) that is recommended depending on the age and gender (14, 15).

Biochemical parameters and blood pressure measurement: Biochemical tests were analyzed at Ankara Atatürk Training and Research Hospital Biochemistry Laboratory. A special attention was paid to make sure that blood sample was taken 12 hours after food consumption. The patients were checked for their hemoglobin, total cholesterol, high density lipoprotein (HDL-chol), low density lipoprotein (LDL-chol), triglyceride (TG), hematocrit (Hct), serum Vitamin D,

and serum calcium levels. The values obtained were analyzed twice, one in prenatal and the other one in postpartum periods. According to serum 25(OH) D status; ≤ 19 ng/mL serum level of Vitamin D corresponds to Vitamin D deficiency; 20-29 ng/mL to Vitamin D inadequacy, 30-150 ng/mL to adequate level, and >150 to toxic level.

Beck Depression Inventory (BDI): BDI is a rating scale consisting of 21 questions, which is applied in order to grade the level of depression indicators and change of violence. Each question is scored between 0-3 and the overall score varies between 0 and 63. According to scores obtained from BDI, 0-9 is classified as minimal; 10-16 as mild; 17-29 as moderate; and 30-63 as severe depression.

Anthropometric Measurements: body weights and heights of women participating in the study were measured by the researcher in line with the measuring techniques, and their BMIs were calculated. Being one of the anthropometric measurements, body weights were measured by using a Sinbo portable electronic scale with 100 g sensitivity. Body heights, on the other hand, were measured by using a SECA diameter; feet positioned together and head maintained in the Frankfort Horizontal Plane (eye and the upper helix on the same level, parallel to the ground). BMI evaluation was conducted in line with WHO criteria (16).

Statistical Analysis: Figures and the percentage distributions of the data regarding socio-demographic features of the individuals participating in the study were calculated. Average, standard deviation, minimum and maximum values were calculated as descriptive statistics of continuous variables; such as age and age of marriage. Figures and the percentage values of variables such as Vitamin D use, gestational week, and commitment to the pregnancy. IBM SPSS Statistics 21.0 (IBM Corp. Released 2012. IBM SPSS Statistics for Windows, Version 21.0. Armonk, NY: IBM Corp.) Software was used for statistical analyses and calculations.

Results

A total of 75 individuals participating in the study used Vitamin D, while the other 75 did not (Table 1). When the gestational week was analyzed, it was found that 17 of them were in the 1st, 35 were in the 2nd, and 98 of them were in the 3rd trimesters. 127 of the pregnancies were found to be planned while the other 23 were unintended pregnancies (Table 1).

Of all the individuals, 122 were in their first, 19 were in the second, 8 were in the third, and the other 1 in her fourth pregnancies (Table 1).

When the biochemical results of the individuals during their prenatal and perinatal periods were analyzed, it was found that;

Median of total cholesterol in prenatal period was found to be 186.50 (IQR=60) and 200.00 (IQR=40.28) in perinatal period; while median of the triglyceride value was found as 140.00 (IQR =23) in prenatal period and 140.00 (IQR =21) in perinatal period. T cholesterol and triglyceride values of the individuals in prenatal and perinatal periods showed statistically significant differences (respectively; $p<0.001$, $p<0.001$) (Table 2).

LDL-cholesterol (mg/dL), hemoglobin, hematocrit, serum Ca and serum Vitamin D values of the individuals in prenatal and perinatal periods also revealed statistically significant differences (Table 2).

In the analysis of the three-day food consumption of the participants;

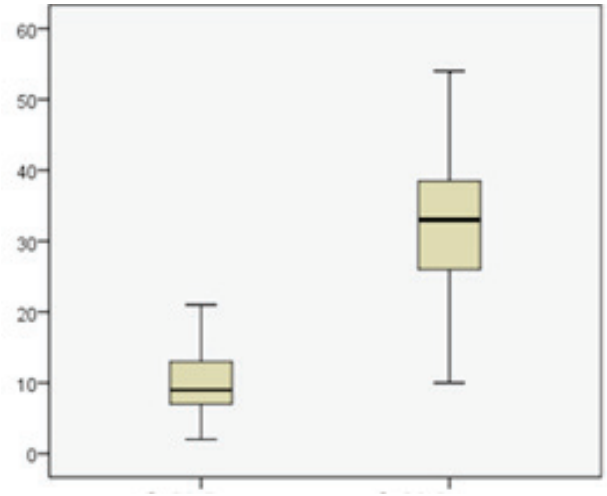
Table 1. Frequency distribution of the individuals clinical features

Individual Features	**n (%)**
Vitamin D Use	
Using	75 (50.0)
Not Using	75 (50.0)
Gestational Week	
First trimester	17 (11.3)
Second trimester	35 (23.3)
Third trimester	98 (65.3)
Willingness for Pregnancy	
Wanted	127 (84.7)
Unwanted	23 (15.3)
Number of Pregnancy	
1	122 (81.3)
2	19 (12.7)
3	8 (5.3)
4	1 (0.7)

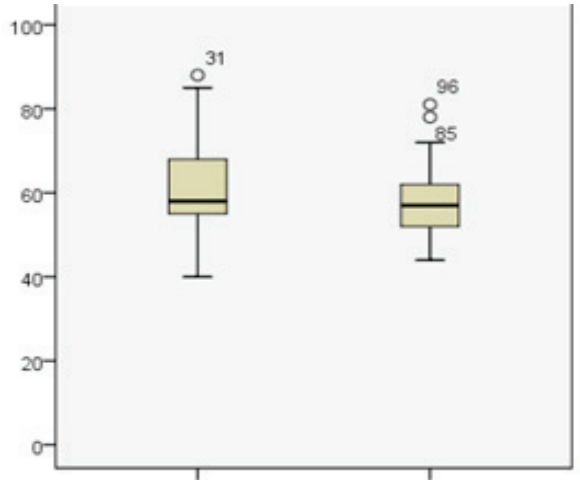
Table 2. Comparison of biochemical findings in prenatal and perinatal periods

Biochemical Findings	Prenatal	Perinatal	Test Statistics	
	Median (IQR)		Z	p
T. Cholesterol (mg/dL)	186.50 (60)	200.00 (40.28)	7.034	<0.001
Triglyceride (mg/dL)	140.00 (23)	140.00 (21)	4.446	<0.001
HDL-cholesterol (mg/dL)	40.00 (10)	40.00 (10)	0.614	0.539
LDL-cholesterol (mg/dL)	100.00 (28)	105.00 (23)	6.952	<0.001
Hemoglobin	12.0 (1)	13.00 (1)	5.495	<0.001
Hematocrit	36.00 (2)	38.50 (4)	9.770	<0.001
Serum Ca	9.00 (1)	9.00 (1)	3.660	<0.001
Serum Vitamin D	30.00 (10)	35.00 (21)	6.509	<0.001

Wilcoxon sign rank test



Beck Depression Plan
Those using Vitamin D Those not using Vitamin D
Figure.1 Comparison of the beck depression score based on Vitamin D use



Prenatal weight
Those using Vitamin D Those not using Vitamin D
Figure.2 Comparison of the weight gained in the first three months based on Vitamin D use

Mean of Vitamin D measurement was calculated as 201.83 ± 74.68 on the first; 213.11 ± 67.58 on the second; and 229.89 ± 71.18 on the third day. Vitamin D values measured for three days showed a statistically significant difference (p=0.001). The groups causing the difference were found to be the 1st and 3rd days.

Mean of carbohydrate measurement was calculated as 52.51 ± 16.23 on the first; 59.81 ± 18.28 on the second; and 50.19 ± 15.19 on the third day. Carbohydrate values measured for three days showed a statistically significant difference (p=0.003).

Mean of unsaturated fat measurement was calculated as 122.56 ± 67.32 on the first; 152.05 ± 105.54 on the second; and 112.47 ± 54.18 on the third day. Unsaturated fat values measured for three days showed a statistically significant difference (p=0.001).

Mean of NA measurement was calculated as 151.55 ± 86.68 on the first; 145.18 ± 88.31 on the second; and 131.91 ± 69.15 on the third day. NA values measured for three days showed a statistically significant difference (p=0.042).

Mean of FE measurement was calculated as 64.81 ± 20.99 on the first; 61.05 ± 25.46 on the second; and 64.18 ± 31.59 on the third day. FE values measured for three days showed a statistically significant difference (p=0.049).

Mean of B2 riboflavin measurement was calculated as 96.57 ± 28.22 on the first; 92.83 ± 37.80 on the second; and 108.73 ±36.25 on the third day. B2 riboflavin values measured for three days showed a statistically significant difference (p=0.001).

Mean of B3 niacin measurement was calculated as 78.80 ± 39.93 on the first; 58.51 ± 22.82 on the second; and 96.16 ± 47.78 on the third day. B3 niacin values measured for three days showed a statistically significant difference (p<0.001).

Mean of B6 measurement was calculated as 100.41 ± 37.49 on the first; 96.29 ± 42.96 on the second; and 106.50 ± 43.48 on the third day. B6 values measured for three days showed a statistically significant difference (p=0.046).

Mean of B12 measurement was calculated as 100.49 ± 29.68 on the first; 71.93 ± 13.30 on the second; and 78.77 ± 13.04 on the third day. B12 values measured for three days showed a statistically significant difference (p<0.001).

Discussion

Although theories on biological, psychological, and environmental depression have been improved, the underlying pathophysiology is still unknown, and it is possible that there are several mechanisms involved (17).

Several factors have been associated with depression. One of the biological factors being considered is malnutrition. Women are particularly sensitive to the adverse effects of malnutrition on mental state. Pregnancy and lactation increase the requirement for nutrients. Reduction in nutrient sources in perinatal period and failure of its retake in postpartum increase women's risk of maternal depression. Deficiencies in folate, Vitamin B_6, Vitamin B_{12}, Vitamin D, calcium,

Table 3. Descriptive statistics of the participants' three-day food consumption

Foods	1st Day M ± SD	2nd Day M ± SD	3rd Day M ± SD	p
Vitamin D	201.83 ± 74.68	213.11 ± 67.58	229.89 ± 71.18	0.001
Energy	72.17 ± 14.59	74.31 ± 18.04	71.94 ± 13.39	0.751
Protein	108.44 ± 40.93	105.27 ± 39.94	109.03 ± 45.83	0.751
Fat	90.91 ± 25.68	95.17 ± 35.22	84.20 ± 25.79	0.113
Carbohydrate	52.51 ± 16.23	59.81 ± 18.28	50.19 ± 15.19	0.003
Unsaturated Fat	122.56 ± 67.32	152.05 ± 105.54	112.47 ± 54.18	0.001
Cholesterol	255.47 ±141.06	274.19 ± 223.71	267.02 ± 162.10	0.515
Total folic acid	62.92 ± 24.03	58.89 ± 24.52	58.43 ± 22.85	0.116
Na	151.55 ± 86.68	145.18 ± 88.31	131.91 ± 69.15	0.042
K	63.71 ± 22.77	62.99 ± 25.15	61.37 ± 26.44	0.506
Ca	64.36 ± 25.57	62.79 ± 31.06	67.81 ± 27.08	0.506
Mg	77.63 ± 21.75	73.33 ± 24.86	77.89 ± 26.77	0.083
Fe	64.81 ± 20.99	61.05 ± 25.46	64.18 ± 31.59	0.049
B1 thiamin	71.47 ± 19.98	72.65 ± 24.07	69.94 ± 21.38	0.901
B2 riboflavin	96.57 ± 28.22	92.83 ± 37.80	108.73 ±36.25	0.001
B3 niacin	78.80 ± 39.93	58.51 ± 22.82	96.16 ± 47.78	<0.001
B6	100.41 ± 37.49	96.29 ± 42.96	106.50 ± 43.48	0.046
B12	100.49 ± 29.68	71.93 ± 13.30	78.77 ± 13.04	<0.001

iron, zinc, and omega 3 fatty acids may increase the possibility of postpartum depression (18).

A study conducted on 23.200 pregnant women proved that using iron and folic acid for a prophylactic purpose is effective for the prevention of iron deficiency and anemia (19).

A study carried out in 2011 in Turkey revealed that 55.7% of the pregnant women take Vitamin B_6 less than half of the recommended daily amount; while this percentage is 100% for folic acid, 85.7% for iron, and 90% for Vitamin D. The study concluded that the nutrient intake levels of pregnant women are usually lower than the recommended amount, and that more than half skip meals during the day (20).

It was also observed that the risk of depression is higher for those who do not eat fish in daily diet and take inadequate amount of omega-3 fatty acids. A meta-analysis revealed that the levels of eicosapentaenoic acid (EPA), docosahexaenoic acid (DHA), and total n-3 fatty acid in people with depression were low. Additionally, excessive intakes of saturated fatty acids and sodium, and excessive sugar consumption were associated with depression. Over-consumption of fast-foods and pastry products rich in carbohydrates may also increase the risk of depression. On the other hand, being rich in fruits, vegetables and wholegrain products, and low in saturated fats, Mediterranean diet is known to be effective in reducing the risk of depression (21).

Recent studies point that Vitamin D may also be associated with depression. The negative relation between 25 (OH)D level and depression has been highlighted in several epidemiological researches. Presence of Vitamin D receptors (VDR) within a location in the brain that may be in relation with depression reinforces the thesis of its role in the etiology of depression (7).

25-Hydroxy Vitamin D and 1.25 (OH) D are distributed to the locations in the brain that can cross the blood-brain barrier, and are linked to Vitamin D receptors and various mood disorders; such as depression and seasonal affective disorders. Some epidemiologic and animal researches also indicate the association between Vitamin D and depression, as well as concern (22).

Although diet is not the most significant source for Vitamin D, oily fish and enriched products can make great contributions to Vitamin D intake. In a research where the relation between Vitamin D intake through diet and the risk of depression; daily amount Vitamin D taken by 81.189 women were identified by obtaining their frequency of food consumption. It was found that women who take Vitamin D by >400 IU/day through diet suffer from depression less by 20%, when compared to those taking Vitamin D by <100 IU/day. In the study, individuals with no depression in the beginning were observed and it was concluded that those taking Vitamin D by >400 IU/day suffered less from depression by 20% when compared to those taking Vitamin D by <100 IU/day (23).

Postpartum depression has also been associated with the level of Vitamin D. It was stated that the low level of serum 25 (OH)D in perinatal period may increase the risk of postpartum depression (24). There is a statistically significant difference between the scores based on Vitamin D use ($p<0.001$).

Presence of VDR in the locations by brain that are correlated with depression, such as prefrontal cortex, hippocampus, cingulate gyrus, thalamus, and hypothalamus indicate the possibility of the role played by Vitamin D in the etiology of depression (23).

Besides, 1 alpha-hydroxylase enzymes that convert 25 (OH) D to 1.25 (OH) D, which is an active form of Vitamin D, were also detected in many of these locations. Based on this, it was stated that Vitamin D may have a neuroendocrine function in the brain. As an active form of Vitamin D, 1,25 (OH) D contributes to the catecholamine synthesis by means of activating the gene expression of tyrosine hydroxylase enzymes. At the same time, it was claimed that it may also contribute to cholinergic functions by means of enhancing acetyl transferase enzyme activities, which is the key enzyme in acetylcholine synthesis (25).

Additionally, it was stated that Vitamin D has a role against oxidative stress in the brain, has an immune-modulator effect, and shows neuro-protective impacts. These mechanisms are thought to play a role in the correlation between Vitamin D and depression (26).

The relation between fish and depression has been highlighted in several studies, and the main role was mostly attributed to omega-3 fatty acids. Besides, fish is known to be the most significant dietary source for

Vitamin D; and it is argued that Vitamin D can also be a factor while illuminating the relation between consuming fish and depression (27).

Hence, recent meta-analyses revealed that there is no clear relation between omega-3 fatty acid intake and depression. In this case, it is thought that the synergic effect of the nutrients in fish may provide protection against depression, in which Vitamin D may play a role (28).

While the rate of women stating that they increase the amount of milk and dairy products during perinatal and lactation periods are 49.8% and 39.1% respectively; only 13.9% and 14.1% of women increase the amount of red meat they eat. On the other hand, the increase in white meat (chicken/turkey) consumption rate during pregnancy was found to be 21.4%. The rates of women who do not eat fish during perinatal and lactation periods are 21.0% and 18.4% respectively; while 24.3% of women was found to increase the amount of fish they consume in perinatal, and 18.9% during lactation period. 40.8% of women (urban: 45.2%, rural: 28.5) said they increase the amount of fish they consume in perinatal period, while this rate is 29.7% (urban: 28.9%, rural: 32.0%) for women in lactation period. 40.6% of women in pregnancy and 65.1% in lactation period do not make any change in the amount of egg they consume. Increasing the consumption of fresh vegetable and fruit is of great importance during perinatal / lactation period. However, it was found that only 66.3% of pregnant women and 40.9% of women in lactation period in Turkey pay attention to that. In Turkey, women consume milk/dairy products by 68% less than they are supposed to, and 61% less food from meat group (29).

World Health Organization suggests that women should be supported with iron, iodine, zinc, folic acid, and Vitamin A in prenatal, perinatal, and lactation periods. Recent studies highlighted that pregnant women should be checked for Vitamin D and provided with Vitamin D supplement when necessary, which is of great importance in terms of maintaining the mother's and baby's health (30).

Daily intake of 2.000 IU Vitamin D_3 towards the end of pregnancy was found to be effective in reducing the risk of perinatal depression (31).

As for women at the risk of depression, it was asserted that low levels of Vitamin D is associated with a higher scores of depressive indicators in early and late pregnancies (9).

Conclusion

Vitamin D deficiency and inadequacy in perinatal period may have negative effects on maternal and baby's health, as well as their future lives. The requirement for Vitamin D increases in perinatal and lactation periods. Pregnant women should be informed about foods that are rich in Vitamin D. According to Vitamin D supplement program, pregnant women who have been given Vitamin D supplement must be followed. Vitamin D supplement is regarded as a low-cost and safe intervention in pregnancy. Perinatal depression is a common problem, affecting the health of women, fetus, infant and the family, negatively. It must be given a special attention, diagnosed early and treated, since it affects the well-being of fetus and the mother negatively, as well as leading to postpartum depression.

Ethical approval: The study was conducted upon obtaining the Ethics Committee Approval from the Ethics Committee of Clinical Trials on 14/11/2018 (No: 18/93).

Informed consent: Informed consent was obtained from all individual participants included in the study.

Compliance with ethical standards: Funding This study doesn't use any source of financial grants or other funding. Conflict of interest Authors haven't got any connection to industrial links and affiliations.

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